DELL PowerVault MD32xxi Deployment Guide for VMware ESX4.1 Server Software

A Dell Technical White Paper
Version 1.3

PowerVault MD3200i and MD3220i Storage Arrays

June 2010

Table of Contents

Terminology/Glossary

VD == virtual disk

VM == virtual machine

NIC == network interface card

MPIO == Multi-Path I/O

SAN == Storage Area Network

RDM == Raw Device Map

DVS == Distributed Virtual Switch

HA == high availability

DRS == Distributed Resource Scheduler

MRU == Most Recently Used

IQN == iSCSI Qualified Name

Introduction

The Dell™ PowerVault™ MD32XXi storage solution consists of either a standard or high availability configuration. The standard (simplex) configuration has a single controller with four 1GbE ports. It can be deployed to support up to 16 hosts non-redundantly. The high availability (duplex) configuration has dual controllers with four 1GbE ports per controller for a total of eight 1GbE ports. The dual controller option can connect up to 32 fully redundant hosts. This document provides instructions to setup the MD32XXi iSCSI storage solution for use with VMware® ESX4.1 Server™ software.

Provisioning of storage on servers in a VM environment is a multi-step process starting with definition of the server names for host access. The iSCSI connection is then established from the storage subsystem. After which, detection and configuration are established as a two-way link with the associated ESX server(s), completing the iSCSI communication subsystem. The final step allocates the detected storage to the individual virtual machines (VMs), where all or part of the configured storage can be assigned to individual VMs.

VMware® vSphere4™ offers many new and advanced enhancements over the iSCSI software initiator in conjunction with iSCSI SAN connectivity. Many of these new features require advanced configuration in order to work properly. Administrators who are familiar with ESX 3.5 iSCSI SAN configuration may find that their current configuration steps are not sufficient to enable all of the advanced features offered in vSphere4.

This whitepaper addresses some of the new features in vSphere4 as well as showing two examples of how to connect a vSphere4 environment to a Dell™ PowerVault™ iSCSI SAN.

These steps are documented in VMware's iSCSI SAN Configuration Guide which can be found on VMware's website but this whitepaper goes into depth on configuration steps for connecting to a PowerVault™ SAN.

This whitepaper also covers steps for utilizing the software iSCSI initiator inside the ESX server. Users connecting their vSphere4 environment using just iSCSI HBAs or users wishing to only assign a single iSCSI NIC with no Jumbo Frame support will not follow these steps and instead configure their environment as normal. Users who wish to only enable Jumbo Frame support for their environment will want to take note of steps 1 and 2 but only create a single VMkernel port through the vCenter GUI after that.

Implementing ESX4.1 on the MD32xxi Storage Array

New Features in vSphere4 Software iSCSI Initiator

VMware vSphere4 ESX4.1 has new support for various new advanced capabilities that were not found in ESX 3.5. This whitepaper will cover the new features in the iSCSI software initiator as well as how to configure them to connect to the SAN.

iSCSI Software Initiator – With ESX4.1, the iSCSI software initiator was re-written from the ground up for better performance and functionality.

Jumbo Frames – With ESX 4.1 and vSphere4, Jumbo Frames can be enabled on the iSCSI software initiator. Jumbo Frame support allows for larger packets to be transferred between the ESX4.1 servers and the SAN for increased efficiency and performance. Jumbo Frame Support can be enabled via the CLI.

MPIO – With ESX4.1 and vSphere4, customers can benefit from Multi-Path I/O from the ESX4.1 server and the SAN. This allows for multiple connections to be concurrently used to allow for greater bandwidth. This is especially important for the PowerVault SAN as each PowerVault member has multiple connections and now ESX4.1 can take full advantage of these connections.

Third Party MPIO Support – With ESX4.1 and vSphere4, VMware has provided an architecture that enables storage vendors to provide new and advanced intelligent integration.

Supported Hardware and Software

Hardware Requirements

Refer to the following VMware website for a complete up-to-date list of the prerequisites for installing VMware ESX server.
http://www.vmware.com/pdf/vsphere4/r40_u1/vsp_40_u1_esx_get_start.pdf

Supported Operating Systems for MD32xxi array

ESX4.1 is the only supported VMware OS for MD32xxi.

Architectural Setup

As a best practice, Dell recommends using a separate Gigabit Ethernet network switch to handle iSCSI storage traffic. Each server is connected to two switches. Each switch has a path to the MD32XXi via two dual-port controllers. In this base HA configuration, the servers, switches, and MD32XXi ports share the same subnet. The NIC ports serving iSCSI traffic on the ESX servers are teamed in order to re-route traffic in the event of an adapter failure.

Considerations When Using iSCSI Software or Hardware Initiators for ESX4.1 on the MD32xxi Storage Array

Taking advantage of all of these new features requires some new steps to be taken by ESX administrators. Configuration is done via either GUI or CLI inside the ESX4.1 server. The remainder of this whitepaper focuses on installation and configuration of an iSCSI software initiator connection to a PowerVault Series SAN. Each of these commands can be found inside the VMWARE ISCSI SAN CONFIGURATION Guide and where names and IP Addresses are used, they will be different for each environment. This serves as an example and demonstration of how to configure a new vSphere4 ESX4.1 server correctly and connect it to the PowerVault SAN.

The following assumptions are made for this example:

1. Running ESX4.1

2. Running latest Dell PowerVault MD32xxi firmware

3. More than one Network Interface Card (NIC) set aside for iSCSI traffic

4. No Distributed Virtual Switch (DVS) for iSCSI traffic

Not every environment requires all of the steps detailed in this whitepaper.

Users wishing to only enable Jumbo Frame support for the iSCSI connection need to follow steps 1 and steps 2 with the following changes:

Step 1: Configure vSwitch and Enable Jumbo Frames – No changes to the instructions

Step 2: Add iSCSI VMkernel Ports – Instead of assigning multiple VMkernel Ports, administrators will only assign a single VMkernel Port

Once these two steps are done, the rest of the configuration can be accomplished in the vCenter GUI by attaching NICs, assigning storage and then connecting to the storage.

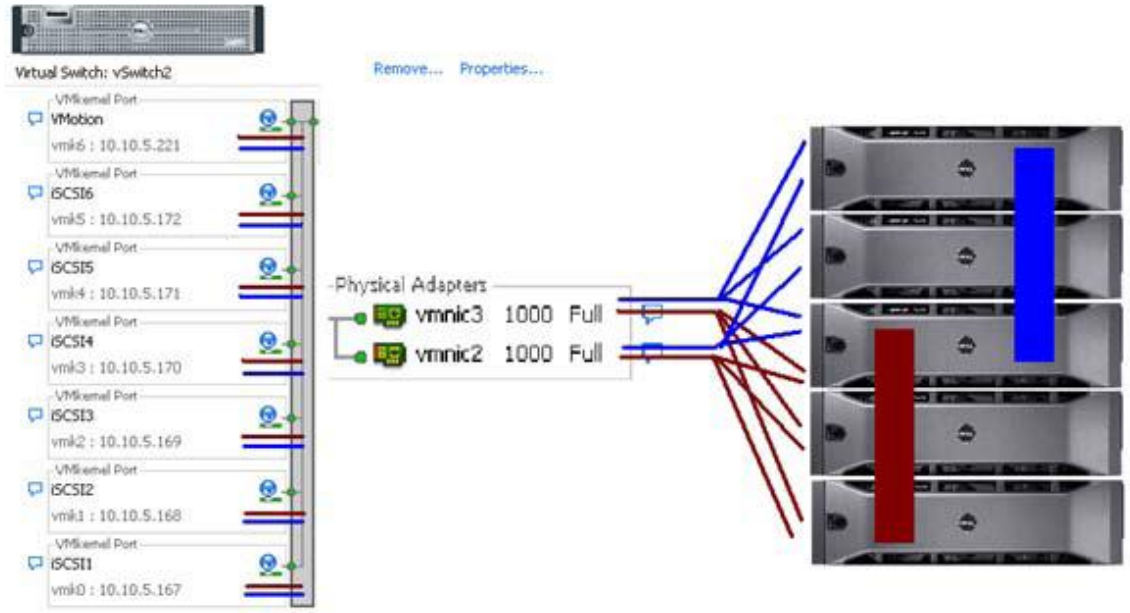
The rest of this document assumes the environment will be using multiple NICs and attaching to a Dell PowerVault SAN utilizing Native Multipathing (NMP) from VMware.

Establishing Sessions to a SAN

Before continuing the examples, we first must discuss how VMware ESX4.1 establishes its connection to the SAN utilizing the new vSphere4 iSCSI Software Adapter. VMware uses VMkernel ports as the session initiators and so we must configure each port that we want to use as a path to the storage. This is independent of the number of network interfaces but in most configurations it will be a one-to-one relationship. Once these sessions to the SAN are initiated, the VMware NMP will take care of load balancing and spreading the I/O across all available paths.

Each volume on the PowerVault array can be utilized by ESX4.1 as either a Datastore or a Raw Device Map (RDM). To do this, the iSCSI software adapter utilizes the VMkernel ports that were created and establishes a session to the SAN and to the volume in order to communicate. With previous versions of ESX, this session was established using a single NIC path and any additional NICs were there for failover only. With the improvements to vSphere4 and MPIO, administrators can now take advantage of multiple paths to the SAN for greater bandwidth and performance. This does require some additional configuration which is discussed in detail in this whitepaper.

Each VMkernel is bound to a physical adapter. Depending on the environment this can create a single session to a volume or up to 8 sessions (ESX4.1 maximum number of connections per volume). For a normal deployment, it is acceptable to use a one-to-one (1:1) ratio of VMkernels to physical network cards. This means if there are 3 physical NICs, you would establish 1 VMkernel per physical NIC and associate a separate NIC with each VMkernel port. In this example you would establish 3 sessions to a single volume on the SAN. This scheme can be expanded depending on the number of NICs you have in the system. As the environment grows, you can establish multiple sessions to the SAN by oversubscribing VMkernel ports to actual physical NICs. This establishes multiple sessions to a volume but still utilizes the same physical NICs as the means to get to the volume. As more PowerVault members are added intelligent routing will come into the picture and allow for dynamic allocation of sessions as the SAN group grows.



PowerVault MD32xxi Storage Setup and Configuration

CREATE VIRTUAL DISKS ON MD32XXI USING STEPS DESCRIBED IN:
http://support.dell.com/support/edocs/systems/md3000i/multlang/gsg/DAO_BCC/DY731A00MR.pdf.

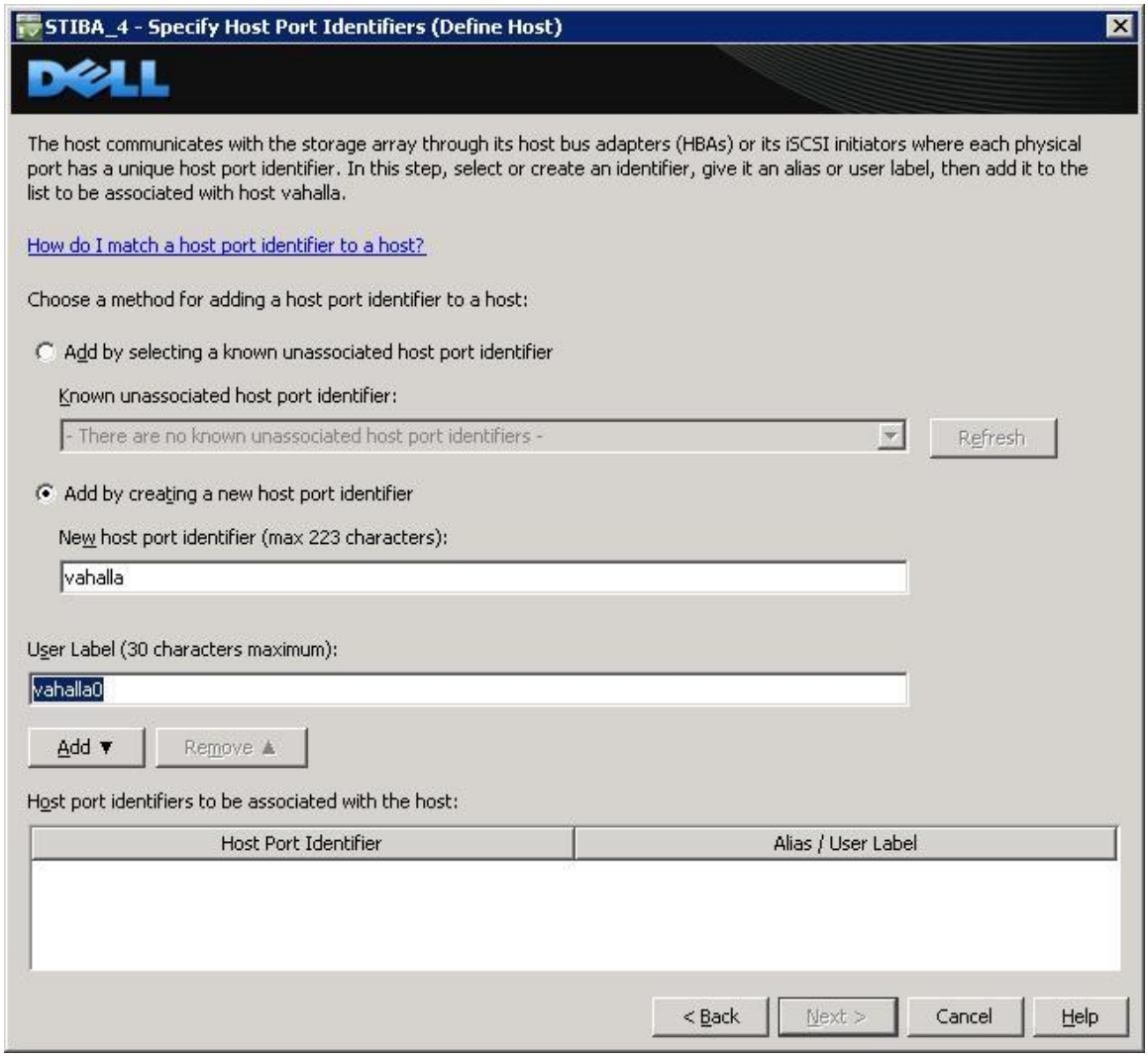
AFTER OPENING THE MODULAR DISK STORAGE MANAGER AND SELECTING THE MD32XXI STORAGE ARRAY TO BE CONFIGURED, SELECT THE *SETUP* TAB.

NOTE: IN THE EXAMPLES TO FOLLOW THE STORAGE ARRAY IS AN MD32XXI WITH VIRTUAL DISKS ALREADY CONFIGURED USING THE *CONFIGURE STORAGE* ARRAY SELECTION. THE NEW SERVER BEING ADDED TO AN EXISTING HOST GROUP IS NAMED "VALHALLA".

FROM THE *SETUP* TAB

1. SELECT *MANUALLY DEFINE HOSTS*.
2. ENTER THE HOST NAME FOR THE SERVER WHICH HAS THE ESX SERVER SOFTWARE IS INSTALLED.
3. SELECT *VMWARE* AS THE HOST TYPE.

From the next screen, specify the iSCSI Initiator by entering a name for the iSCSI initiator. The label is auto-populated from the server name.

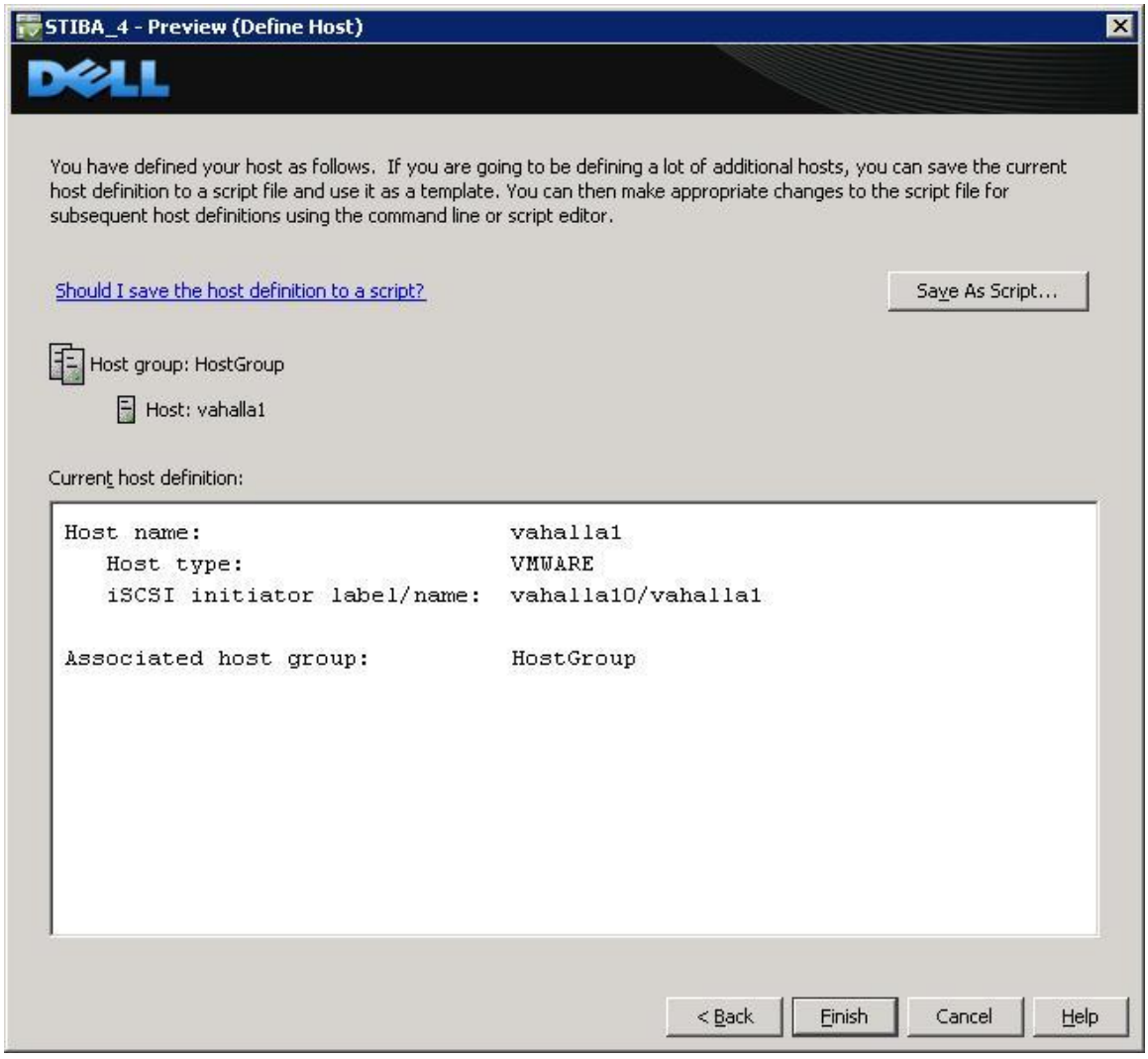


Host Group configuration starts from the screen titled “Manually Define Hosts”. For ESX servers supporting VMotion, HA, and DRS (Distributed Resource Scheduler), a host group must be defined so the MD32xxi storage subsystem has a configured iSCSI path to each of the hosts.

- Select “Yes: This host will share access to the same virtual disks with other hosts”

- If a new host group is desired select the radio button for that option and enter in a name for your host group using standard host naming conventions (e.g. no spaces etc.).
- Should you already have one or more host groups assigned, select the radio button enabling selection from a drop down list of existing host groups. This option is to be used when configuring the second, third, etc. host in a group. Once the host group is selected, previously configured hosts for that host group will be displayed. Note that these are shown as VMware hosts.

Selecting *Next* provides a Confirmation screen in which the new server being configured is shown and the other previously configured associated hosts are named. For the first server configured in a new host group there will be no associated hosts listed under the *Associated host group*.



Select *Finish* confirming the new host definition. This initiates the wizard configuration of the new host.

On completion,

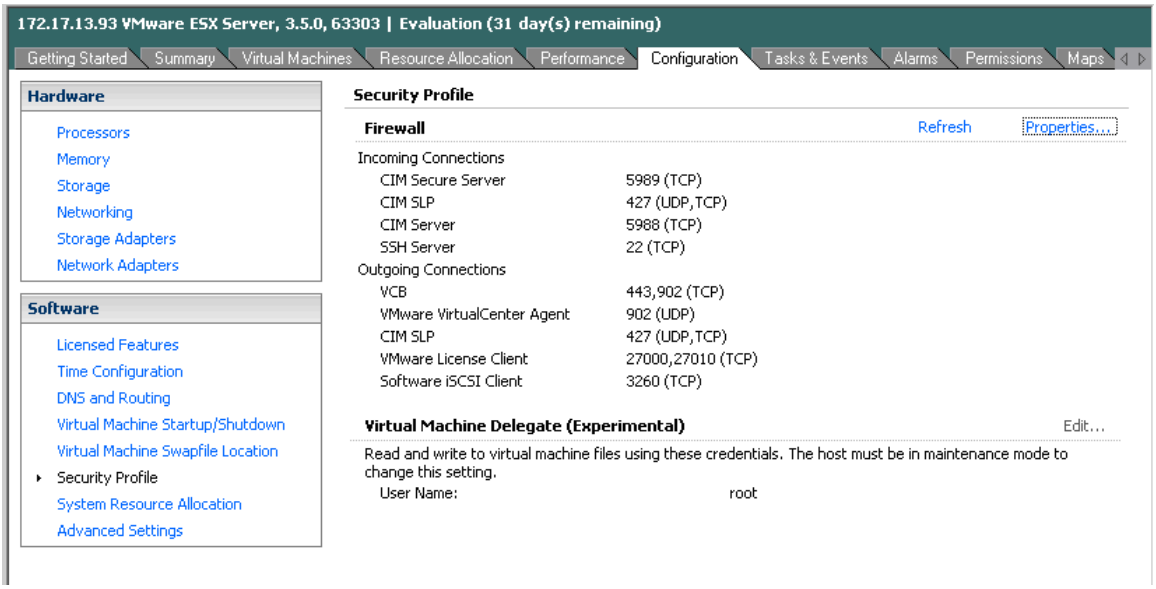
- Select *Yes* to proceed to the next host you wish to configure, or
- Select *No* to end the configuration wizard.

Helpful Hint: Record the MD32xxi IP address for later configuration

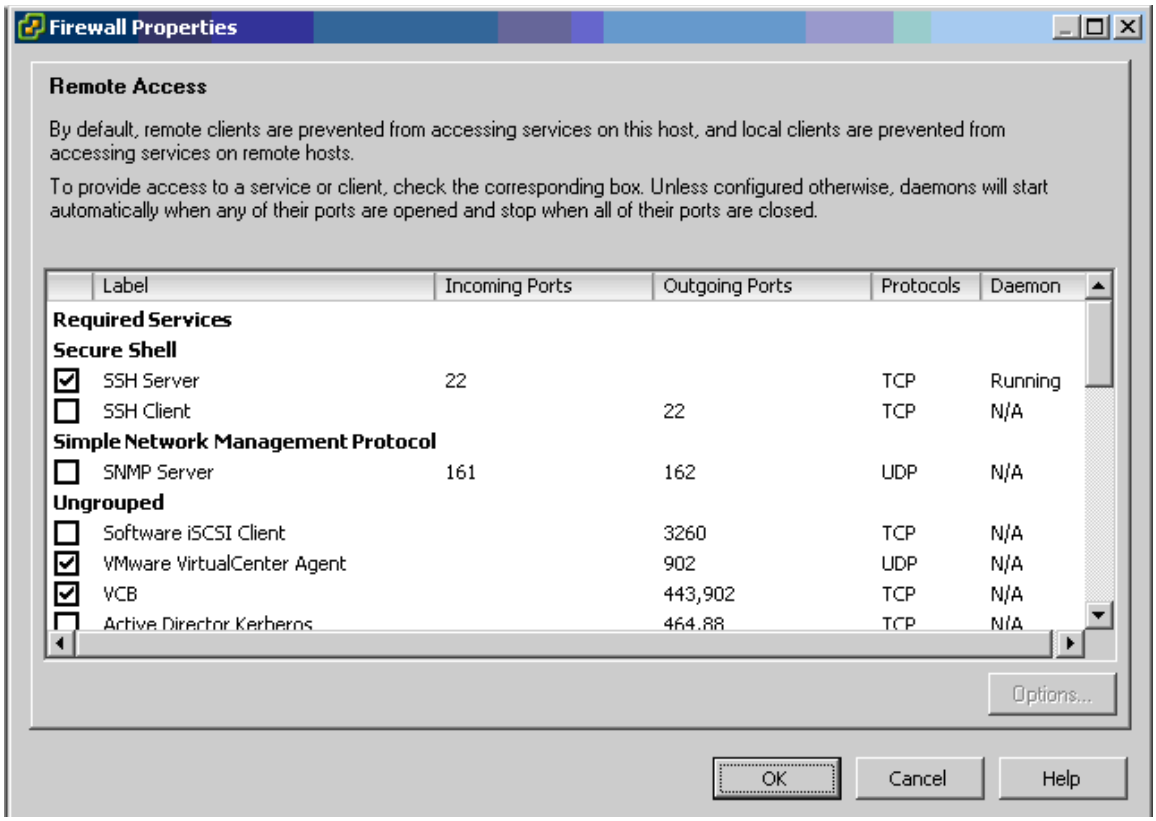
iSCSI Software Initiator Configuration on ESX4.1 Server

This section lists the steps required to configure the software initiator on the VMware ESX4.1 Server. Connect to the ESX4.1 server/vCenter using VI Client, and follow these steps:

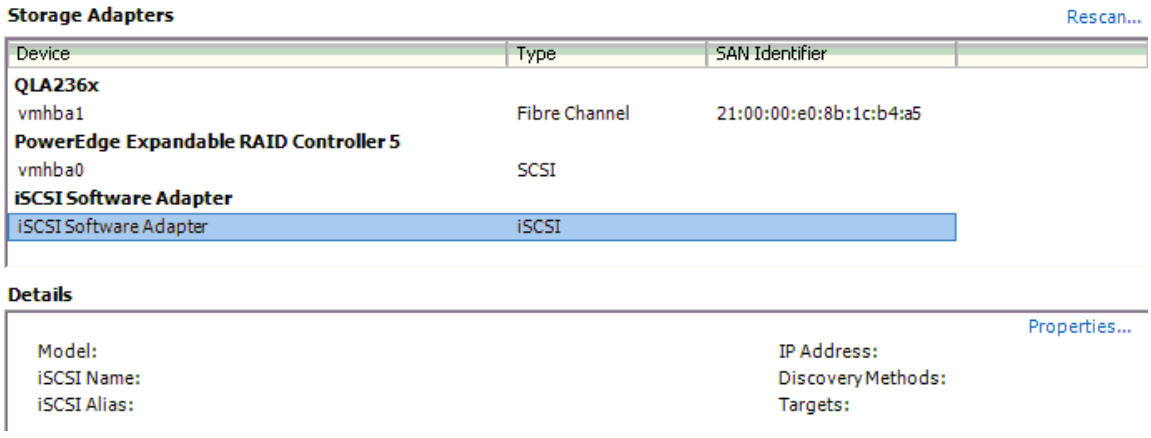
1. Select ***Configuration->Security Profile*** on the ESX server.



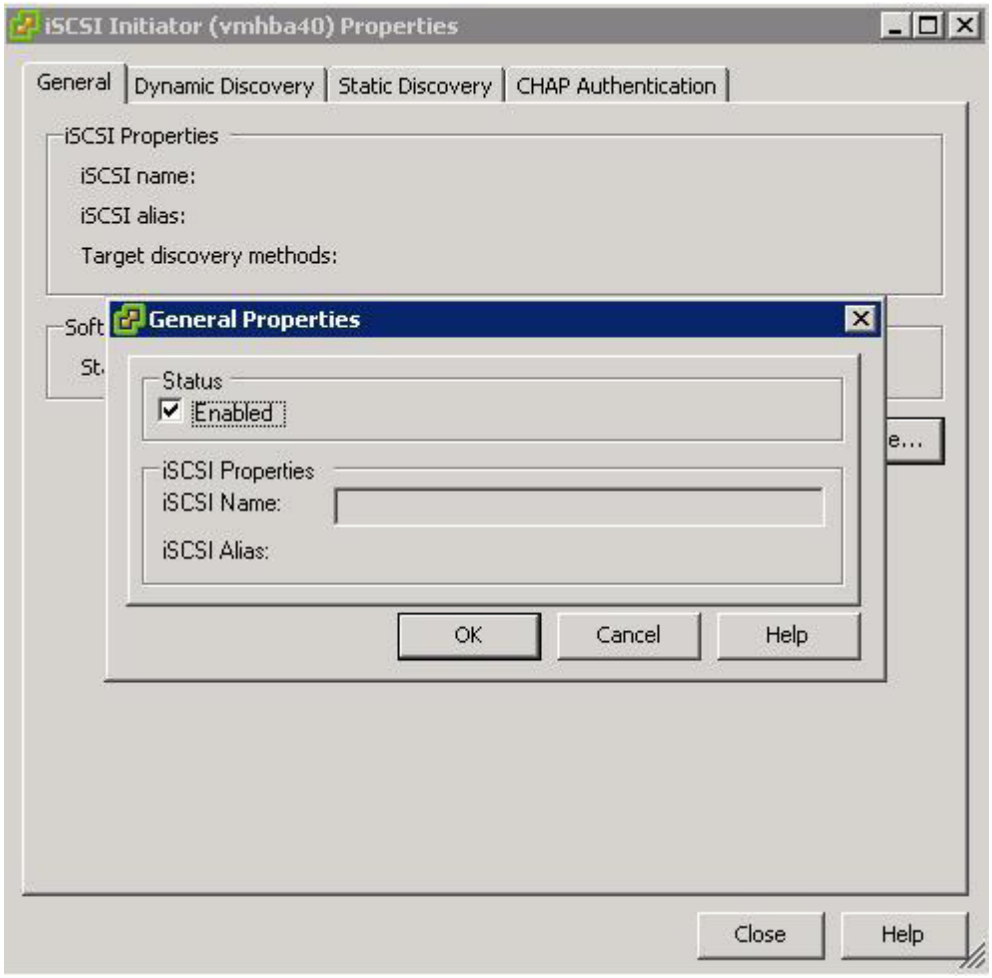
2. Click on *Properties*. The *Firewall Properties* box appears.



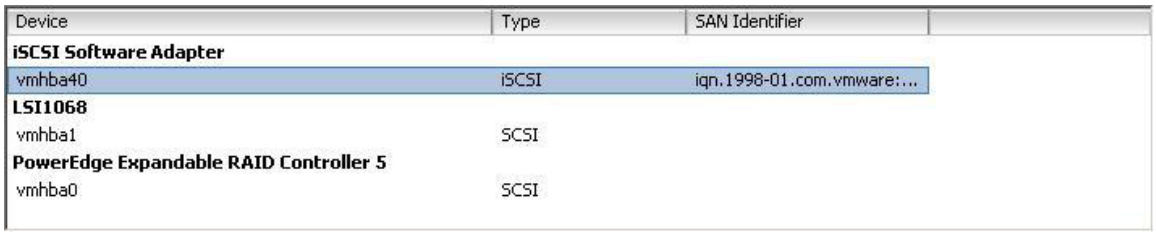
3. Check *Software iSCSI Client* option.
4. Select *Configuration->Storage Adapters* on the ESX4.1 server.
5. Select *iSCSI Software Adapter* and click on *Properties.*



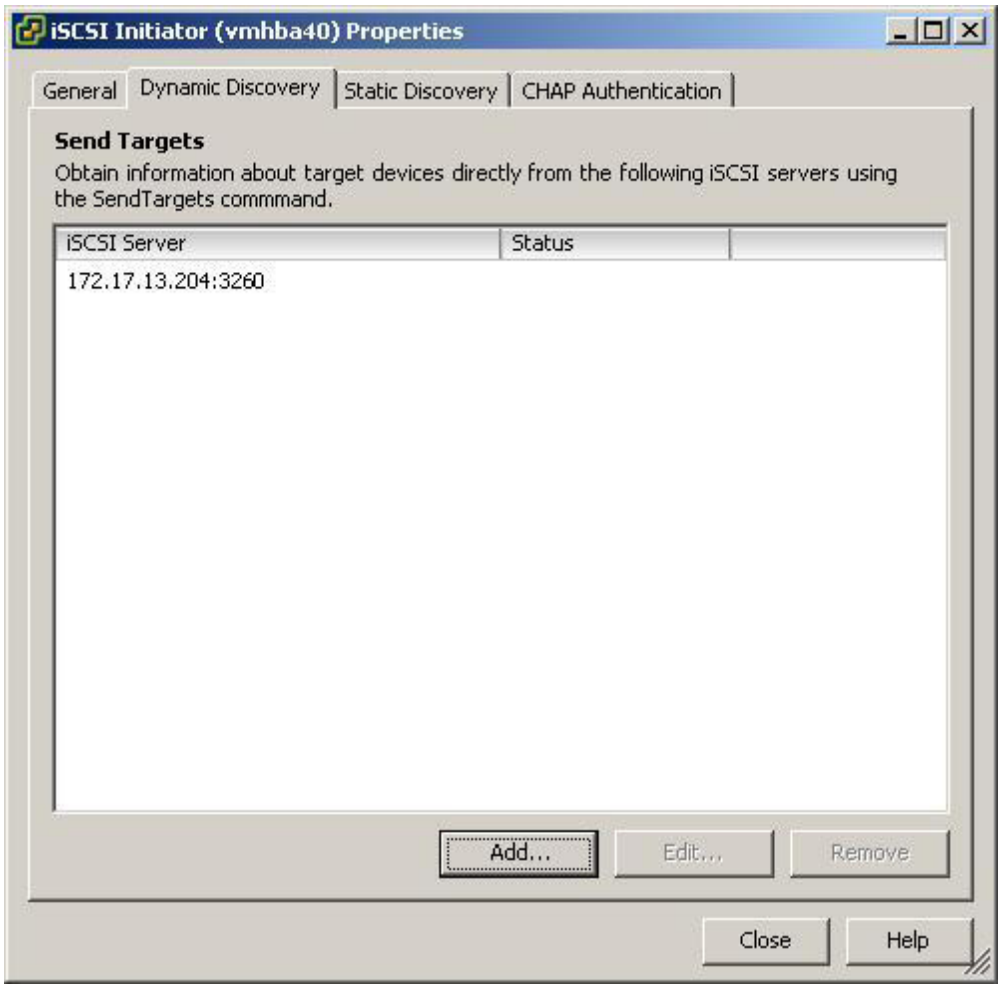
6. The iSCSI initiator Properties window appears.
7. Under the General tab select Configure tab. Select the ***Enabled*** checkbox and click *OK*. Select Close.



8. Select ***iSCSI Software Adapter*** under ***Storage Adapters.*** You should now see your iSCSI Target name listed.



9. Select Properties under storage adapters. Select Dynamic Discovery. Select ***Add***. Provide the IP address of the MD32xxi iSCSI Target Port and click ***OK***. There may be a slight delay before the process completes.



10. Click *Close*.

Clustering with ESX4.1 / Creating DRS Clusters

Refer to the following VMware website for a complete up-to-date list of the prerequisites for clustering with ESX4.1 server.
http://www.vmware.com/pdf/vsphere4/r40/vsp_40_mscs.pdf

Configure iSCSI storage on ESX4.1 Server - Example Installation Steps

Connect to the ESX server/vCenter using VI Client and follow the steps below.

Go to the configuration tab and select *Storage Adapters*. Select the iSCSI Software Adapter and click *Rescan*. The newly created iSCSI target and LUN should be visible from the ESX server.

Step1: Configure vSwitch & Enable Jumbo Frames

This step will create a new vSwitch and enable Jumbo Frame support for this switch. This step is used for both examples no matter the number of VMkernels or physical NICs. Currently there is no option to enable Jumbo Frames on a vSwitch from VMware vCenter GUI so these commands must be run via CLI. Be sure to check the environment to make sure that Jumbo Frames are supported at the networking layer before enabling it on the ESX host.

The following command will create a new vSwitch called vSwitch2:

esxcfg-vswitch –a vSwitch2

Next, enable Jumbo Frames on the vSwitch:

esxcfg-vswitch –m 9000 vSwitch2

To verify that the switch was configured properly run the following command:

esxcfg-vswitch –l

Your output will look similar to this:

Switch Name	Num Ports	Used Ports	Configured Ports	MTU Uplinks
vSwitch2	64	1	64	9000

You can note the new vSwitch2 with the MTU of 9000 to verify that the switch was created correctly. You can also see it displayed in the GUI of vCenter. Throughout these procedures some of the verification can be done via command line or seen in the vCenter GUI. The polling rate of vCenter is not instant so changes will not show up immediately after it is typed.

Step2: Add iSCSI VMkernel Ports

This next step will assign VMkernel Ports to the new vSwitch2. It will also configure Jumbo Frame support as well as assign the IP Addresses. Administrators familiar with iSCSI connectivity in ESX3.5 will find that it is no longer required to configure a Service Console port for the iSCSI connection. Another thing to notice is that because the Service Console is not needed, the iSCSI switch environment can be on a different subnet than the public environment or existing service console. Each VMkernel Port will need its own IP Address and they must all be on the same subnet and be on the same subnet as the PowerVault IP Address.

There are some suggested configurations depending on the number of NICs that will be used for iSCSI traffic. Every environment will differ depending on the number of hosts, the number of members, and the number of volumes.

In a default configuration assign one VMkernel port for each physical NIC in the system. So if there are 3 NICs, assign 3 VMkernel Ports. This is referred to in the VMware's iSCSI SAN Configuration Guide as 1:1 port binding.

In the two examples provided, both a 1:1 relationship with 3 physical NICs and a 3:1 relationship with 2 physical NICs are shown.

VMware vCenter has a maximum of 8 connections to a single volume. In this whitepaper we choose 3 connections in the 1:1 scenario and 6 connections in the 3:1 scenario. This provides scalability and performance as the SAN environment grows without having to make changes on each ESX host.

If fewer connections are desired follow the above sample configurations to obtain the number of VMkernel Ports that match the environment and the number of paths you need.

Always keep the entire virtual datacenter in mind when deciding on path and volume count. View the Release Notes of the PowerVault Firmware for the current connection limits for the Dell PowerVault.

All of these configurations are done for the vSwitch itself. This means that once it is done, the ESX4.1 host will create multiple connections to the PowerVault SAN. Every new volume will have more connections as well. Once this is configured there only need to be changes made if more NICs are being added or if more or less paths are needed.

Note: Host profiles do not keep information on Jumbo Frames or Port Bindings.

For the rest of this whitepaper the configuration steps and commands will be given for the 1:1 binding. See Appendix A for an example of the 3:1 VMkernel port binding.

The following command will add a new iSCSI VMkernel Port named iSCSI1 on the vSwitch created in the previous step.

```
esxcfg-vswitch –A iSCSI1 vSwitch2
```

This next command will configure the IP Address, Subnet Mask and enable Jumbo Frame support for the new VMkernel Port iSCSI1

```
esxcfg-vmknic –a –i 10.10.5.173 –n 255.255.255.0 –m 9000 iSCSI1
```

For our example with a 1:1 relationship with 3 NICs we need to create 2 more VMkernel Ports named iSCSI2 and iSCSI3

```
esxcfg-vswitch –A iSCSI2 vSwitch2

esxcfg-vmknic –a –i 10.10.5.174 –n 255.255.255.0 –m 9000 iSCSI2

esxcfg-vswitch –A iSCSI3 vSwitch2

esxcfg-vmknic –a –i 10.10.5.175 –n 255.255.255.0 –m 9000 iSCSI3
```

To verify the configuration enter the following command:

esxcfg-vswitch –l

The output will look similar to this:

Switch Name	Num Ports	Used Ports	Configured Ports	MTU Uplinks
vSwitch2	64	7	64	9000

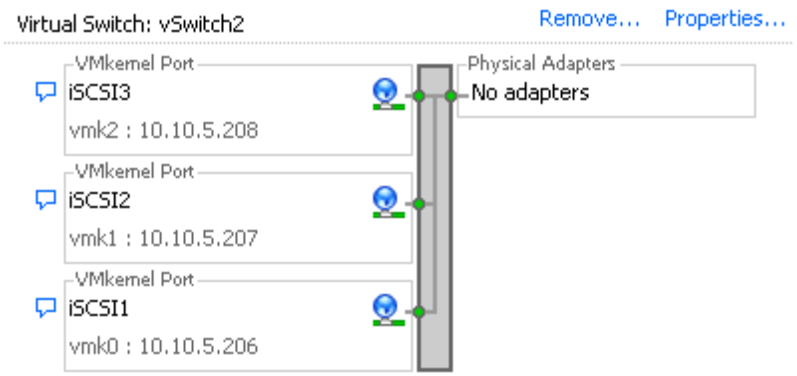
PortGroup Name	VLAN ID	Used Ports	Uplinks
iSCSI3	0	1	
iSCSI2	0	1	
iSCSI1	0	1	

This will show the VMkernel ports that are assigned to the vSwitch. To verify the IP addresses enter the following command:

esxcfg-vmknic –l

The output will look similar to the graphic below.

You can also verify the IP Addresses via the vCenter GUI. In vCenter, on the ESX Host, navigate to ***Configuration -> Networking***.



Step3: Assign Network Adapters

The next step in the process is to assign the network adapters (NICs) that will be attached to the iSCSI network and used for iSCSI traffic. These will be attached to the vSwitch2 that we created earlier. This can be done two ways, in the vCenter GUI or by CLI.

To list all of the adapters in the system run the following command:

esxcfg-nics –l

The output will look similar to this:

```
Name    PCI         Driver     Link Speed Duplex MAC Address        MTU

vmnic0 03:00.00 bnx2 Up 1000Mbps Full      00:21:9b:8b:4b:b0 1500
```

This will list all of the adapters in the system. Assign the NICs that are physically connected to the SAN infrastructure and to the vSwitch. The following command assumes that we are assigning vmnic1, vmnic2, and vmnic3 to the vSwitch.

esxcfg-vswitch –L vmnic1 vSwitch2

esxcfg-vswitch –L vmnic2 vSwitch2

esxcfg-vswitch –L vmnic3 vSwitch2

Once again, to verify the configuration type the following command to list the vSwitch information:

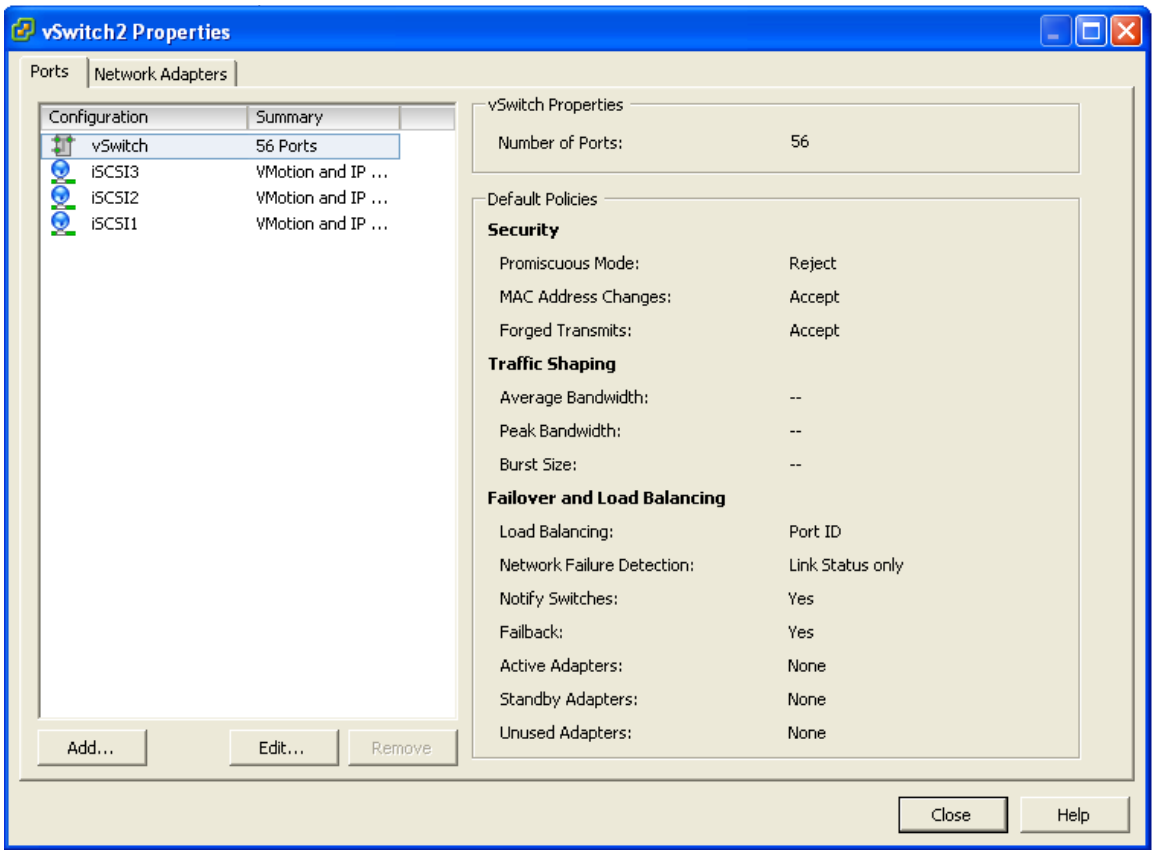
esxcfg-vswitch –l

Your output will look similar to the following. Note the new vmnics that were assigned to the vSwitch under uplinks.

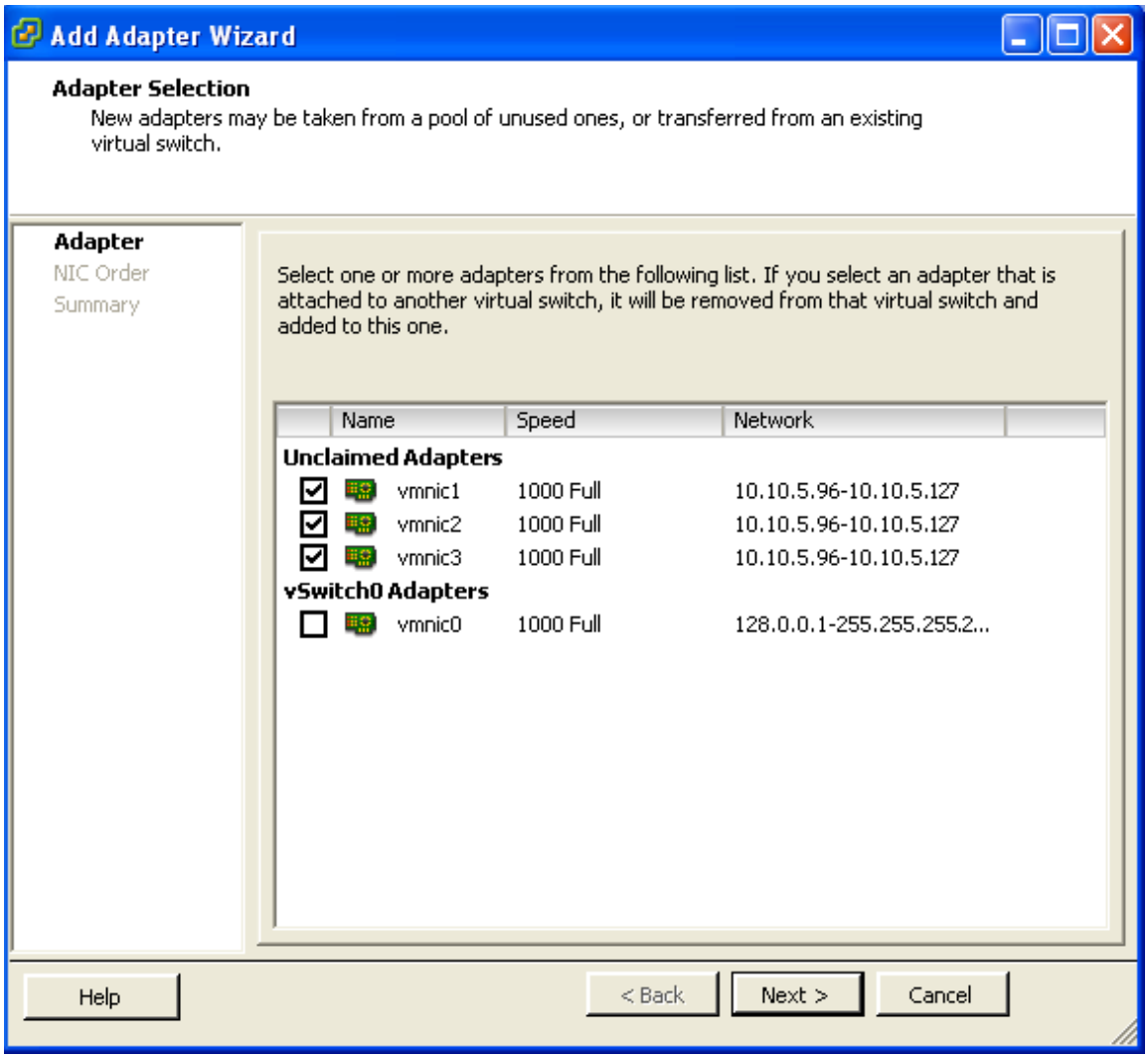
```
Switch Name    Num Ports    Used Ports    Configured Ports MTU Uplinks
vSwitch2            64             9                64                  9000

PortGroup Name VLAN ID Used Ports         Uplinks
iSCSI3                      0                 1                 vmnic1,vmnic2,vmnic3
iSCSI2                      0                 1                 vmnic1,vmnic2,vmnic3
iSCSI1                      0                 1                 vmnic1,vmnic2,vmnic3
```

Adding a NIC can also be configured and verified in the vCenter GUI. Remember that the polling of vCenter is not instant so a refresh might need to occur to see the latest changes. To configure this same process from the GUI, first navigate to the Networking section on the ESX host you are configuring. ***Configuration -> Networking***.

From here, click ***Properties*** on the vSwitch2.



Click the ***Network Adapters*** tab. Then click ***Add***. This will open up the Add Adapter Wizard. From here select the vmnics that you want to add to the vSwitch. In our example it will be vmnic1, vmnic2 and vmnic3.



Click ***Next*** after you have selected the chosen adapters. For now keep the defaults listed in the Failover Order screen and click ***Next***. Review the adapters listed and click ***Finish*** completing the process.

These adapters will now show up in the GUI under the Network Adapters tab.

Step4: Associate VMkernel Ports to Physical Adapters

The next step is used to create the individual path bindings for each VMkernel to a NIC. This is required in order to take advantage of the new advanced features such as Most Recently Used(MRU) MPIO or 3rd party MPIO plug-ins available from Dell.

From our previous step there are 3 VMkernel ports and 3 NICs. This means that each NIC will have 1 VMkernel ports assigned to it. Again, each environment will differ and these numbers can change based on the number of NICs and the number of paths assigned.

This process can be done either via CLI or through the vCenter GUI.

By default, all the vmnics are assigned to each VMkernel port. We need to remove all but one vmnic from each VMkernel port so that each VMkernel port has only one uplink.

Before running these commands the switch information looks like the following (obtained using *esxcfg-vswitch –l* again):

Switch Name	Num Ports	Used Ports	Configured Ports	MTU	Uplinks
vSwitch2	64	7	64	9000	

PortGroup Name	VLAN ID	Used Ports	Uplinks
iSCSI3	0	1	vmnic1,vmnic2,vmnic3
iSCSI2	0	1	vmnic1,vmnic2,vmnic3
iSCSI1	0	1	vmnic1,vmnic2,vmnic3

You can see that there are three vmnics in each uplink for each VMkernel Port. This is what we need to change so that only a single vmnic is in each uplink and that we manually load balance them across all available VMkernel Ports.

To configure this process via CLI first note the vmnic number of a NIC you want to remove and type the following command:

esxcfg-vswitch –p iSCSI1 –N vmnic3 vSwitch2

What this will do is remove vmnic3 from VMkernel port iSCSI1 so that now vmnic1 and vmnic2 are left on iSCSI1. We then need to remove vmnic2 so that only vmnic1 is associated with the iSCSI1. To do this type the following command:

esxcfg-vswitch –p iSCSI1 –N vmnic2 vSwitch2

Now that we have just one vmnic associated with one VMkernel port we need to remove the excess NICs on the other ports.

esxcfg-vswitch –p iSCSI2 –N vmnic1 vSwitch2

esxcfg-vswitch –p iSCSI2 –N vmnic3 vSwitch2

esxcfg-vswitch –p iSCSI3 –N vmnic1 vSwitch2

esxcfg-vswitch –p iSCSI3 –N vmnic2 vSwitch2

To verify that this was done correctly type the following command:

esxcfg-vswitch –l

The output will look similar to this:

Switch Name	Num Ports	Used Ports	Configured Ports	MTU	Uplinks
vSwitch2	64	7	64	9000	

PortGroup Name	VLAN ID	Used Ports	Uplinks
iSCSI3	0	1	vmnic3
iSCSI2	0	1	vmnic2
iSCSI1	0	1	vmnic1

The important thing to note is that under the Uplinks section there is only one vmnic assigned to each iSCSI VMkernel port and that they are evenly distributed across them.

This can also be done through the vCenter GUI. To configure this from the GUI first navigate to the Networking section on the ESX host you are configuring. ***Configuration -> Networking***.

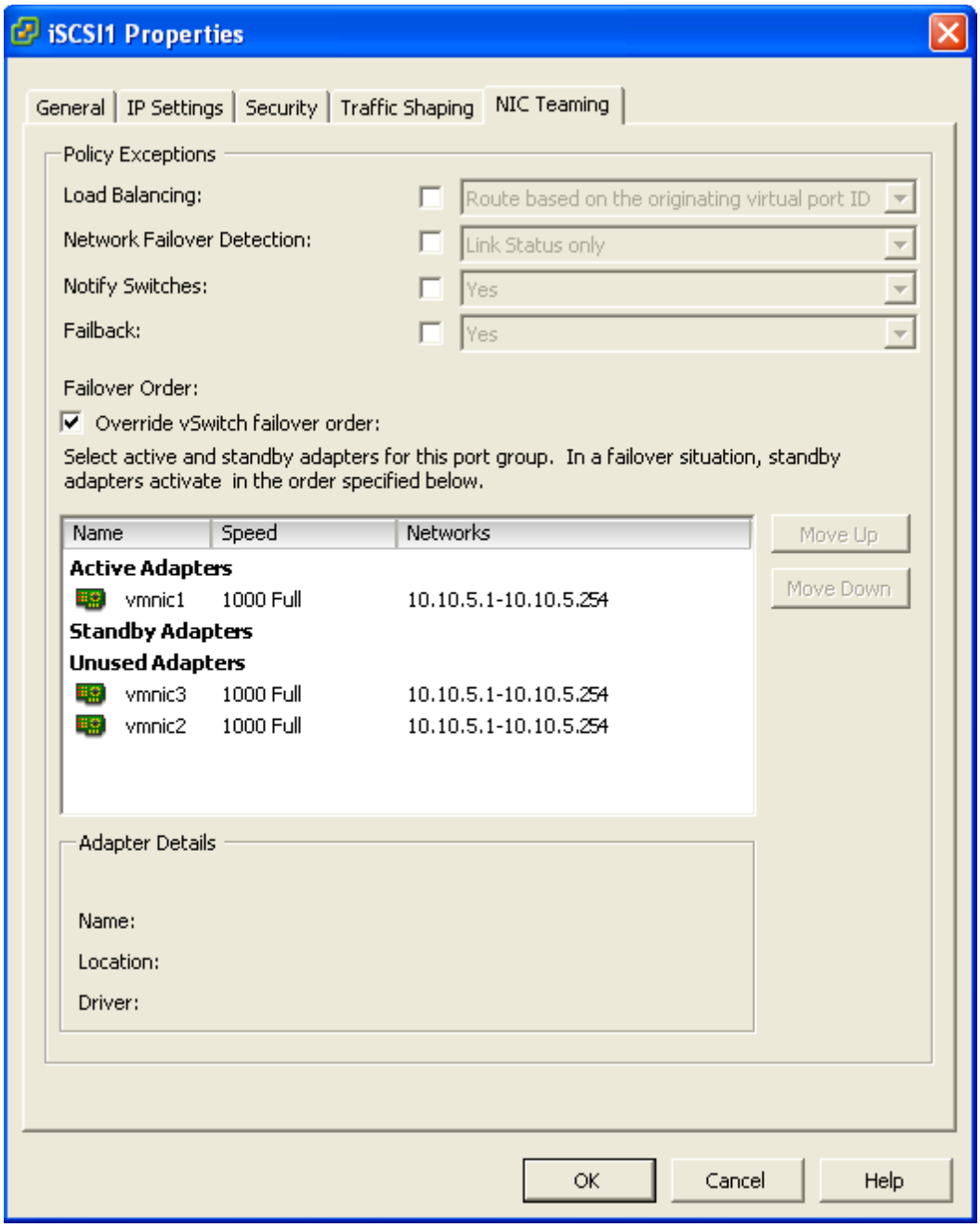
From here, click ***Properties*** on the vSwitch2.

Select one of the VMkernel Ports, in this example iSCSI1 and click ***Edit***.

From here select the ***NIC Teaming*** tab.

Here you are going to select the check box for ***Override vSwitch failover order***.

Just like in the CLI example we will assign vmnic1 to iSCSI1. This is done by selecting the adapters that are not going to be assigned to the VMkernel (vmnic2 and vmnic3 in this case) and clicking the ***Move Down*** button until it is listed under Unused Adapters. The following figure shows the completed result. Click ***Ok*** to complete the process. Do this same thing for each of the iSCSI VMkernel ports so that each VMkernel port is mapped to only one adapter and they are all balanced. In this example we assigned iSCSI1to vmnic1, iSCSI2 to vmnic2 and iSCSI3 to vmnic3.



Step5: Enable VMware iSCSI Software Initiator

The next step, if it has not been done already, is to enable the iSCSI initiator to prepare the ESX host to connect to the PowerVault SAN. This can be done either through a CLI command or through the vCenter GUI.

To enable the iSCSI initiator through the CLI type the following command:
esxcfg-swiscsi –e

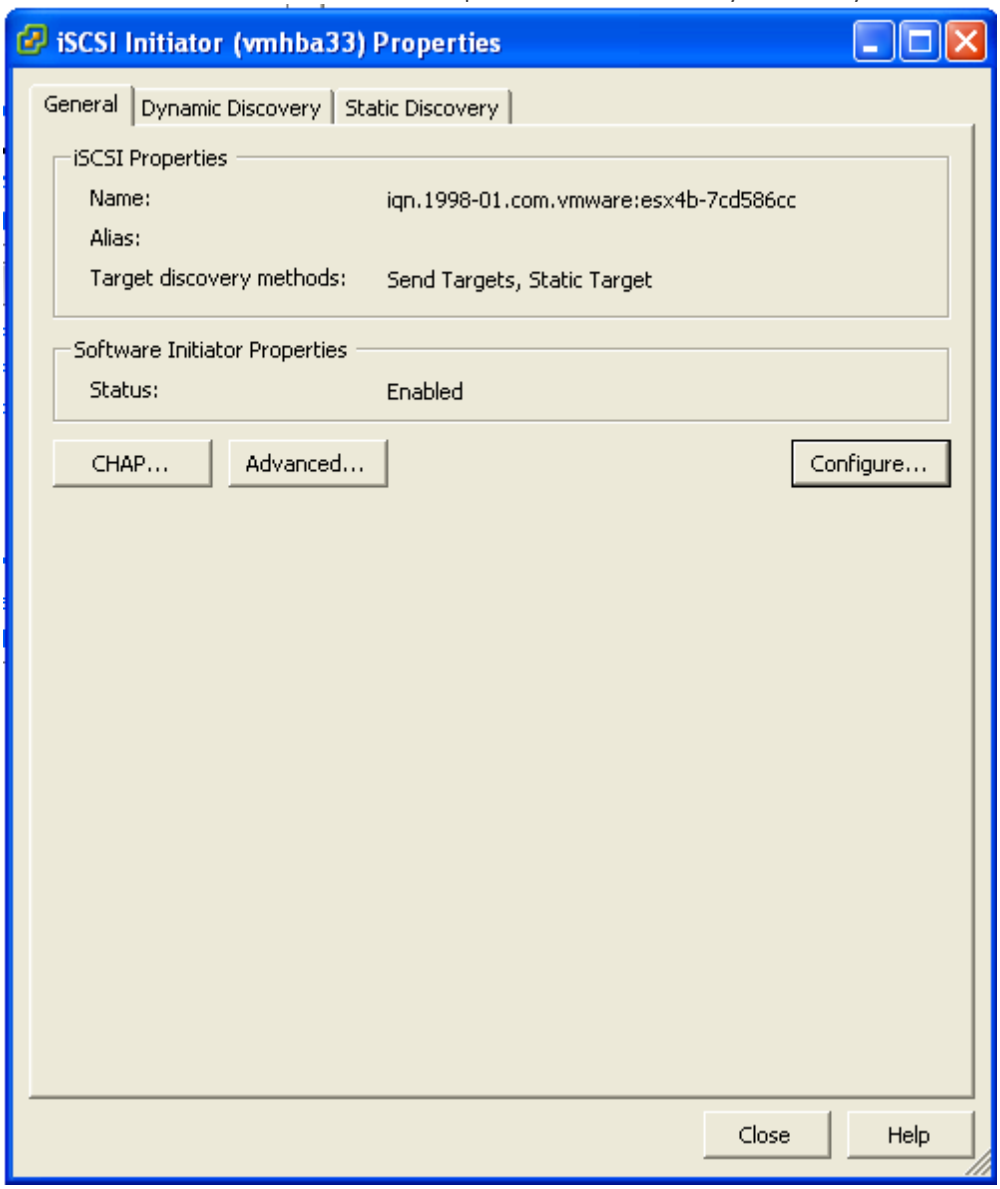
This will enable the software iSCSI initiator. To verify that it is enabled type the following command:

esxcfg-swiscsi –q

This can also be accomplished by using the vCenter GUI.

From the vCenter GUI on the ESX host navigate to ***Configuration -> Storage Adapters***. Select the iSCSI Software Adapter and click ***Properties***.

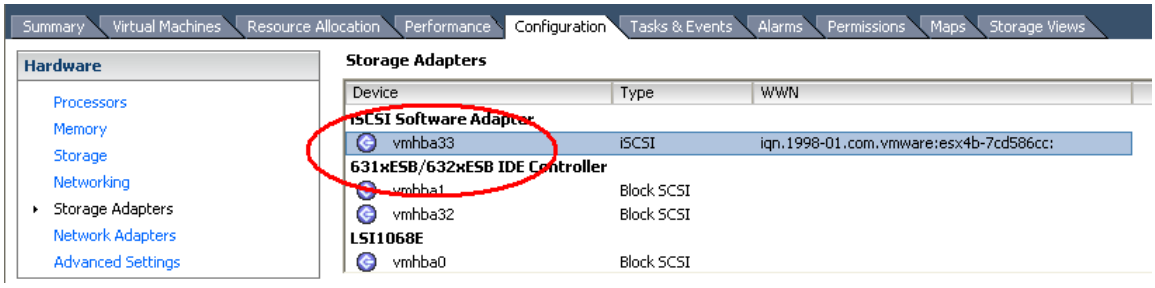
Under the General tab click the ***Configure*** button. Place a check mark in ***Enabled*** and hit ***Ok***. This will enable the iSCSI initiator and assign a unique iqn to the ESX host. Administrators familiar with enabling iSCSI in ESX 3.5 will notice that the firewall policies are automatically set when you enable it in vSphere4.



Step6: Binding VMkernel Ports to iSCSI Software Initiator

This next step will bind the VMkernel ports, which were configured in Step 4 earlier, to the iSCSI Software Initiator. If this step is skipped there will only ever be a single connection to the PowerVault SAN. This step must be done via CLI.

The first thing to do is to note the vmhba# of the iSCSI Software Initiator. This can be seen in the vCenter GUI on the ESX host under ***Configuration -> Storage Adapters***.



This can also be found by running the following CLI command to discover all SCSI devices including the iSCSI software adapter:

esxcfg-scsidevs –a

The output will look something like the following:

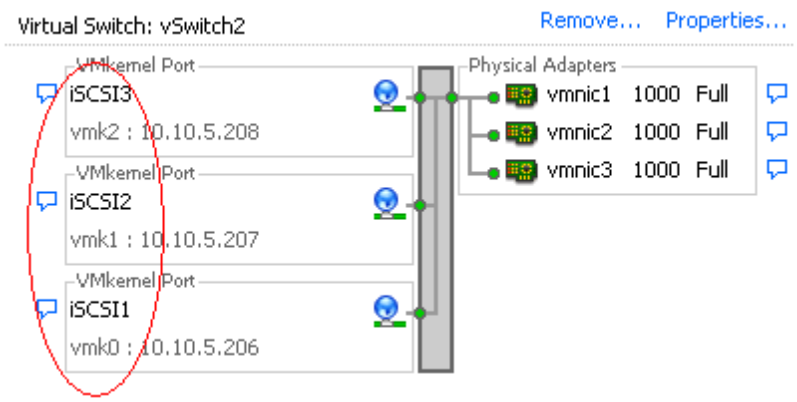
vmhba0 mptsas link-n/a sas.5001ec90e0ba7c00
(1:0.0) LSI Logic / Symbios Logic LSI1068E
vmhba1 ata_piix link-n/a ide.vmhba1
(0:31.1) Intel Corporation 631xESB/632xESB IDE Controller
vmhba32 ata_piix link-n/a ide.vmhba32
(0:31.1) Intel Corporation 631xESB/632xESB IDE Controller
vmhba33 iscsi_vmk link-n/a iscsi.vmhba33
() Software iSCSI

In this example from both the GUI and CLI we can determine that the vmhba# for the iSCSI Software Initiator is vmhba33. This will be used in the next part. This will differ on various systems based on the devices installed.

The next piece of information to gather is the vmk# of each of the VMkernel ports. This can be done via the GUI or CLI.

To determine the vmk# of each VMkernel port from the vCenter GUI navigate to ***Configuration -> Networking***. From the vSwitch that was created earlier under each VMkernel port, the vmk# will be listed.

NOTE: It is important to recognize that they may not start with vmk0, vMotion ports and other VMkernels will utilize the same numbers based on the order they are created.



In this example we see that iSCSI1 is vmk0, iSCSI2 is vmk1, and iSCSI3 is vmk2. This is also information that we need to note.

We can also see this in the CLI by using the following command:

esxcfg-vmknic –l

The output will look similar to this:

Interface Port Group/DVPort IP Family IP Address
Netmask Broadcast MAC Address MTU TSO MSS
Enabled Type
vmk0 iSCSI1 IPv4 10.10.5.173
255.255.255.0 10.10.5.255 00:50:56:7b:d8:3e 9000 65535 true
STATIC
vmk1 iSCSI2 IPv4 10.10.5.174
255.255.255.0 10.10.5.255 00:50:56:7e:ae:80 9000 65535 true
STATIC
vmk2 iSCSI3 IPv4 10.10.5.175
255.255.255.0 10.10.5.255 00:50:56:74:a4:e0 9000 65535 true
STATIC

We can determine this same information from the GUI.

Now that we know the vmhba# and the vmk# we can map each VMkernel Port to the iSCSI Software Initiator. This is done through the CLI by typing the following command:

esxcli swiscsi nic add –n vmk0 –d vmhba33

This will bind the vmk0 VMkernel port to the iSCSI Software Adapter vmhba33. We then proceed to bind all of the other vmk# to the same vmhba.

esxcli swiscsi nic add –n vmk1 –d vmhba33

esxcli swiscsi nic add –n vmk2 –d vmhba33

To verify that all of the vmk# are bound properly to the vmhba run the following command:

esxcli swiscsi nic list –d vmhba33

This will list all of the information for VMkernel ports that are assigned to the iSCSI Software Adapter.

Step7: Connect to PowerVault MD32XXi Storage

Now that the advanced configuration for the vSphere4 iSCSI Software Initiator has been completed, the next stage is to connect to the Dell PowerVault SAN and to the volumes it contains.

More information for complete administration of the Dell PowerVault SAN can be found in the PowerVault User's Guide. In this example we will attach the iSCSI Software Initiator to the SAN and to a single volume. We will skip configuring CHAP but both one way and bi-directional CHAP is supported by the PowerVault SAN.

The first thing to do is add the PowerVault IP Address to the dynamic discovery of the ESX Host iSCSI Software Initiator. This is done to enable rescans to find new volumes that can be seen by ESX and used to create Datastores.

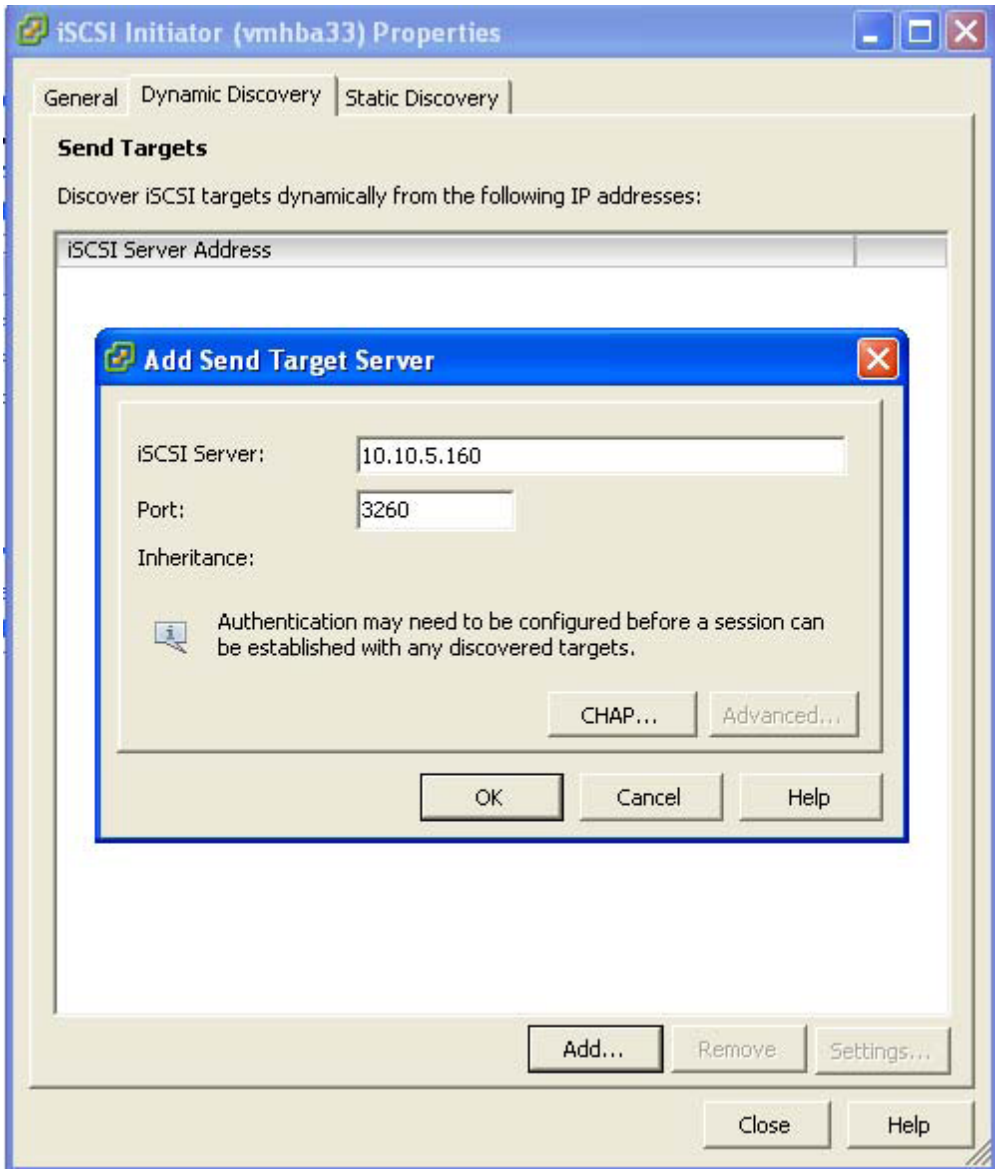
To configure this, navigate in the vCenter GUI to ***Configuration -> Storage Adapters***.

Click on the iSCSI Software Adapter and click ***Properties***.

Click the ***Dynamic Discovery*** tab.

Click ***Add***.

In the iSCSI Server box type in the IP Address of the PowerVault SAN and hit ***Ok***.

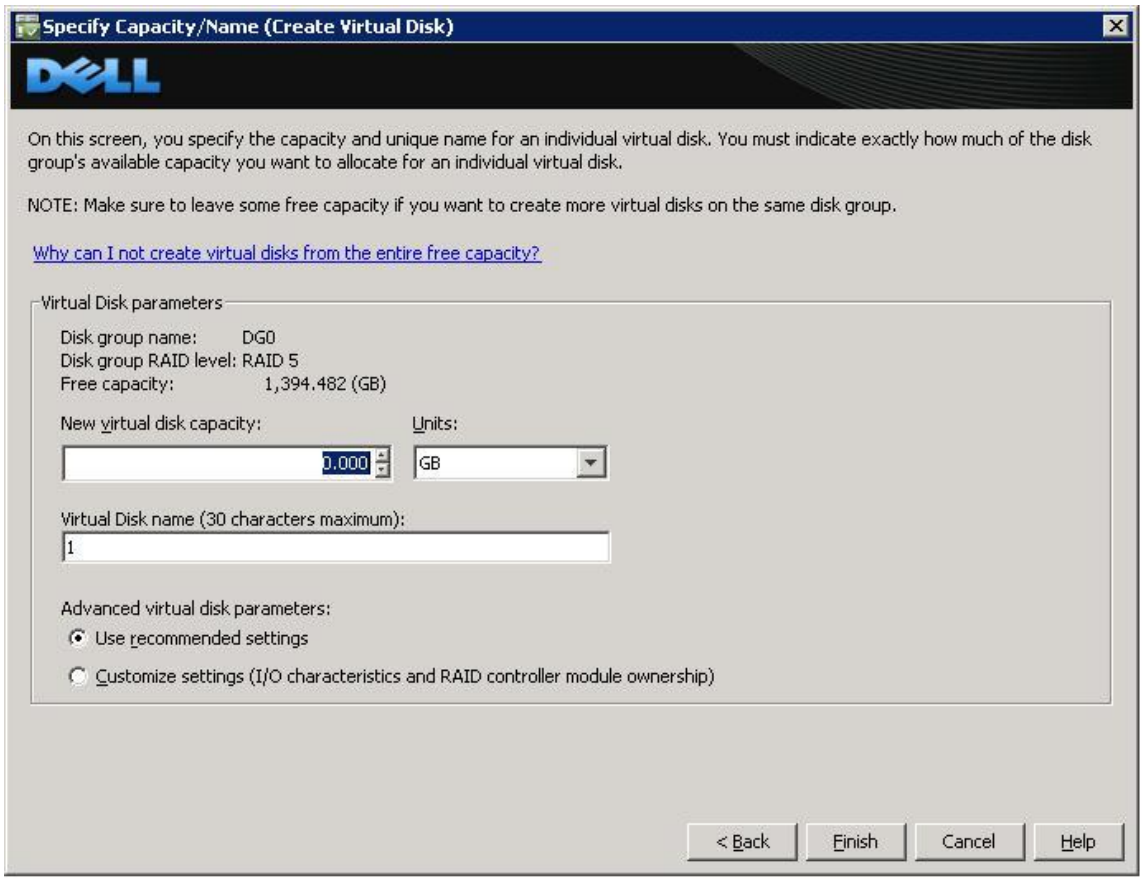


When this is done click ***Close*** or enter in another IP Address if there are multiple SANs in your environment.

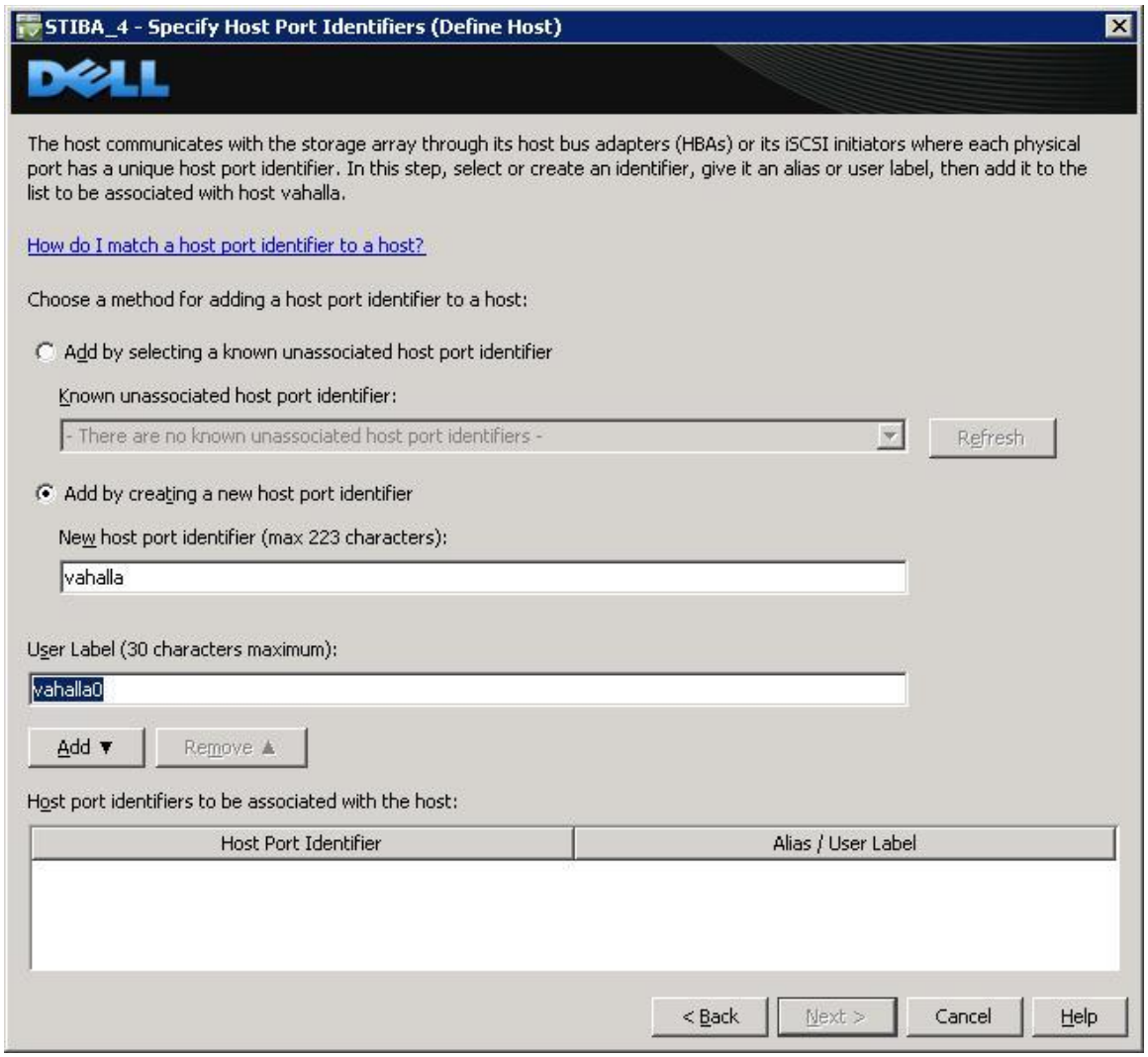
You will be prompted for a Rescan of the HBAs but at this time as there are no volumes assigned it is unnecessary.

The next step will be to create a new volume and assign it to the ESX server. This can be done multiple ways so refer to the PowerVault User's Guide for more information. In this example we will create a 100GB Volume and assign it to this ESX host via the iqn name.

Create a new volume named '1'.

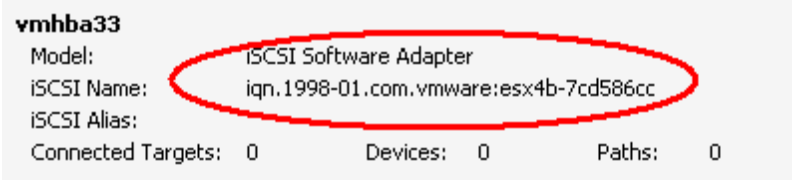


1. Set the volume size and keep the rest of the defaults and click ***Finish***.

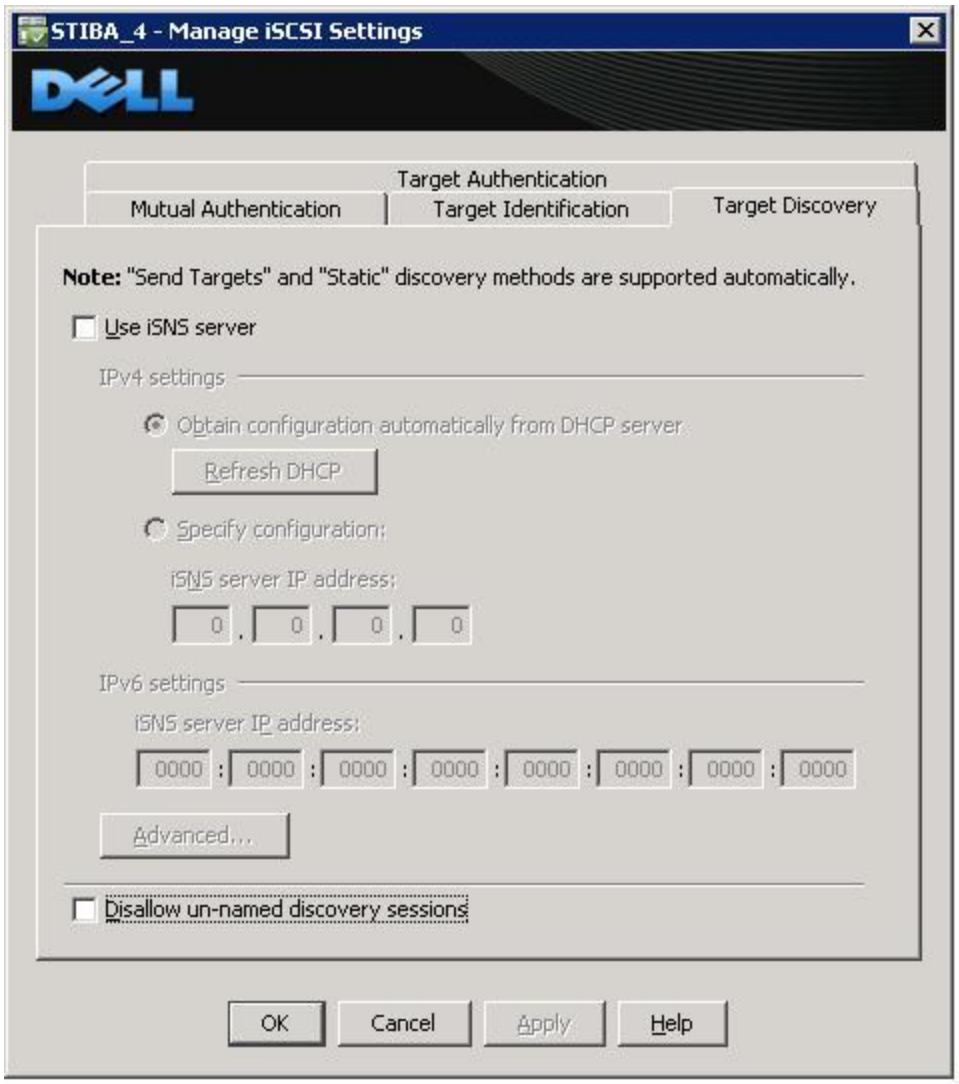


2. Under iSCSI Access you can choose to use an IP Address or Initiator Name.

3. To find the iSCSI Initiator Name from the vCenter GUI go to ***Configuration -> Storage Adapters***. Click on the iSCSI Software Adapter. The iqn can be copied and pasted into the Group Manager interface for the Initiator Name.



There is another check box option for “Disallow un-named discovery sessions”.



4. Check ***Disallow un-named discovery sessions***, if desired.

Step8: Connect to a Volume on PowerVault SAN

The next step is to connect to the volume on the SAN and verify the connection status. Since the iSCSI access and configuration was configured in the last step, the only thing to do now is to rescan the HBAs and make sure the volume appears correctly.

In the vSphere4 GUI click on ***Configuration -> Storage Adapters*** and select the iSCSI Software Adapter.

Click ***Rescan All*** and choose to Scan for New Storage Devices and select ***Ok.***

When this is done, if everything has been configured properly under Devices there will be a new PowerVault iSCSI Disk with the correct size similar to what's shown below.

Step9: Enabling VMware Native Multipathing – MRU

One of the new advanced features that is enabled by configuring the iSCSI Software Initiator the way we have is that now we can take advantage of MPIO by using MRU. This combined with the fan-out intelligent design of the PowerVault group allows for greater and better bandwidth utilization than in previous versions of ESX.

To configure MRU Multipathing on a volume, select the volume from the vCenter GUI. ***Configure -> Storage***. Right click and select ***Manage Paths***. This will display the path information with the default of fixed path.

To enable MRU select the drop down next to Path Selection and choose MRU(VMware). This will reconfigure the volume to utilize a load balancing policy going across all available paths.

NOTE: This needs to be done for every existing and new volume that you want the MRU policy for.

To verify that all of the configuration settings were made correctly, in the PowerVault Storage Manager, select the Volume and then click the ***Connections*** tab.

Step10: Create VMFS Datastores and Connect More Volumes

Now that the iSCSI Software vSwitch is set up and configured, follow steps 8-9 for each additional new Volume that is created. Each Volume can also be formatted VMFS and utilized as normal.

Each existing Volume can be modified to allow multiple ESX servers to attach to it by adding the Initiator Name in the Access Tab inside the Group Manager. See the PowerVault User's Guide for more information on adding more access control connections to a volume.

Contact Information

HTTP://SUPPORT.DELL.COM/SUPPORT/TOPICS/GLOBAL.ASPX/SUPPORT/PRODUCT_SUPPORT/PRODUCT_SUPPORT_CENTRAL?C=US&CS=555&L=EN&S=BIZReferences

VMware vSphere 4.1 Documentation:

http://www.vmware.com/support/pubs/vs_pages/vsp_pubs_esxi41_e_vc41.html

Dell/VMware alliance home page:

http://www.dell.com/vmware

Appendix A

This appendix details an example of how to over commit the number of VMkernel ports to the physical NICs. This is usually done in environments in which the NIC is capable of handling multiple sessions such as 10GbE. This can also be done in larger environments combined with a PowerVault SAN to help achieve maximum bandwidth to the SAN.

In this appendix example we are using 2 physical NICs and assigning 3 VMkernel ports to each one for a total of 6 sessions to the SAN.

Step A1: Configure vSwitch and Enable Jumbo Frames

Follow the Step 1 configuration steps in the main document as there are no changes for adding multiple VMkernel ports.

Step A2: Add iSCSI VMkernel Ports

The following command will add a new iSCSI VMkernel Port named iSCSI1 on the vSwitch created in the previous step.

esxcfg-vswitch –A iSCSI1 vSwitch2

This next command will configure the IP Address, Subnet Mask and enable Jumbo Frame support for the new VMkernel Port iSCSI1

esxcfg-vmknic –a –i 10.10.5.173 –n 255.255.255.0 –m 9000 iSCSI1

Following the example from before we are just adding more VMkernel ports. We need to create 5 more VMkernel Ports named iSCSI2, iSCSI3, iSCSI4, iSCSI5 and iSCSI6. Then configure the IP addresses, subnet masks and enable Jumbo Frames.

esxcfg-vswitch –A iSCSI2 vSwitch2
esxcfg-vmknic –a –i 10.10.5.174 –n 255.255.255.0 –m 9000 iSCSI2

esxcfg-vswitch –A iSCSI3 vSwitch2

esxcfg-vmknic –a –i 10.10.5.175 –n 255.255.255.0 –m 9000 iSCSI3

esxcfg-vswitch –A iSCSI4 vSwitch2
esxcfg-vmknic –a –i 10.10.5.176 –n 255.255.255.0 –m 9000 iSCSI4

esxcfg-vswitch –A iSCSI5 vSwitch2
esxcfg-vmknic –a –i 10.10.5.177 –n 255.255.255.0 –m 9000 iSCSI5

esxcfg-vswitch –A iSCSI6 vSwitch2
esxcfg-vmknic –a –i 10.10.5.178 –n 255.255.255.0 –m 9000 iSCSI6

To create less VMkernel Ports just skip iSCSI5 and iSCSI6 for example.

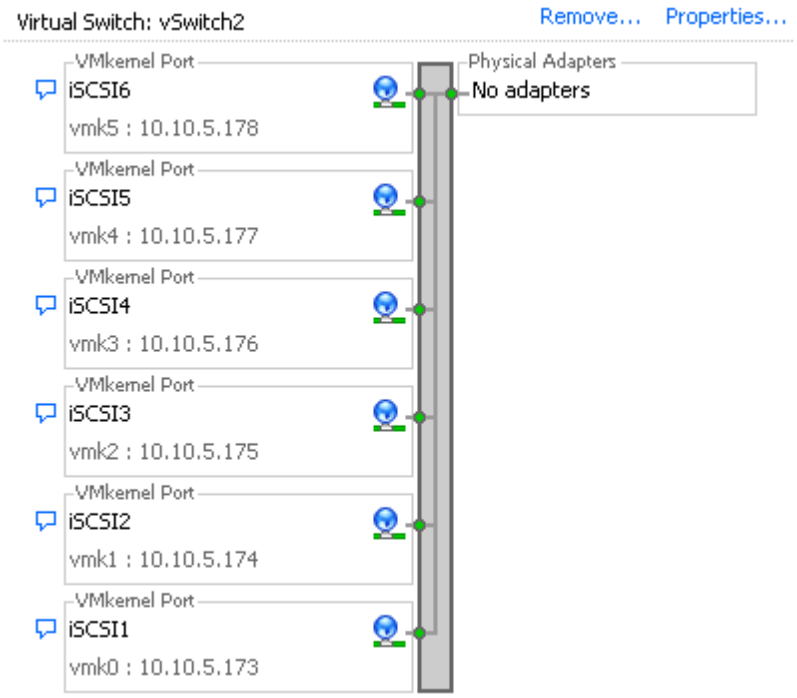
To verify the configuration enter the following command:

esxcfg-vswitch –l

This will show the VMkernel ports that are assigned to the vSwitch. To verify the IP addresses enter the following command:

esxcfg-vmknic –l

You can also verify the IP Addresses via the vCenter GUI. Navigate to ***Configuration -> Networking***.



Step A3: Assign Network Adapters

Just like in the previous example, the next step in the process is to assign the network adapters (NICs) that will be attached to the iSCSI network and used for iSCSI traffic. These will be attached to the vSwitch2 that we created earlier. This can be done two ways, in the vCenter GUI or by CLI.

To list all of the adapters in the system run the following command:

esxcfg-nics –l

This will list all of the adapters in the system. Assign the NICs that are physically connected to the SAN infrastructure and to the vSwitch. The following command assumes that we are assigning vmnic2 and vmnic3 to the vSwitch.

esxcfg-vswitch –L vmnic2 vSwitch2

esxcfg-vswitch –L vmnic3 vSwitch2

Once again to verify the configuration type the following command to list the vSwitch information:

esxcfg-vswitch –l

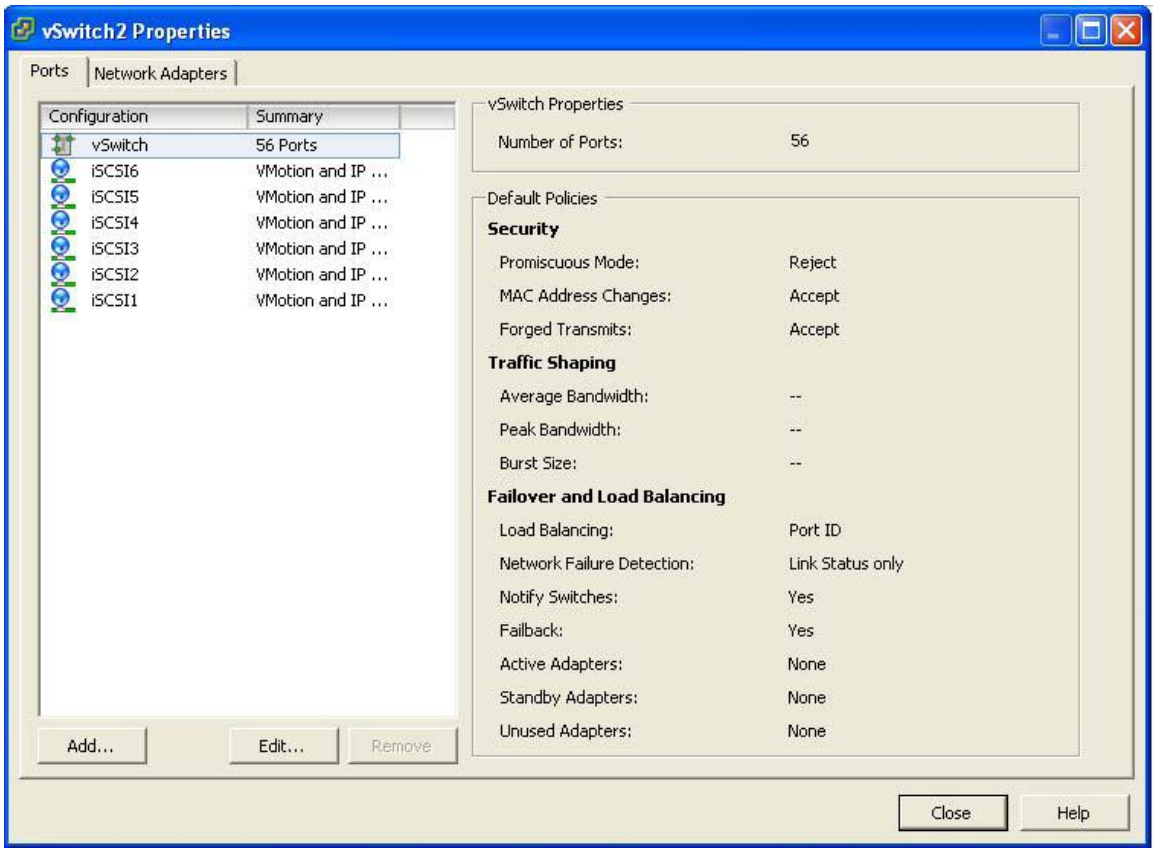
Your output will look similar to the following. Note the new vmnics that were assigned to the vSwitch under uplinks.

Switch Name	Num Ports	Used Ports	Configured Ports	MTU	Uplinks
vSwitch2	64	9	64	9000	vmmnic3,vmnic2

PortGroup Name	VLAN ID	Used Ports	Uplinks
iSCSI6	0	1	vmnic2,vmnic3
iSCSI5	0	1	vmnic2,vmnic3
iSCSI4	0	1	vmnic2,vmnic3
iSCSI3	0	1	vmnic2,vmnic3
iSCSI2	0	1	vmnic2,vmnic3
iSCSI1	0	1	vmnic2,vmnic3

This can also be configured and verified in the vCenter GUI. Remember that the polling of vCenter is not instant so a refresh might need to occur to see the latest changes. To configure this same process from the GUI, first navigate to the Networking section on the ESX host you are configuring. ***Configuration -> Networking***.

From here, click ***Properties*** on the vSwitch2.



Click the ***Network Adapters*** tab. Then click ***Add***. This will open up the Add Adapter Wizard. From here select the vmnics that you want to add to the vSwitch. In our example it will be vmnic2 and vmnic3.

Click ***Next*** after you have selected the chosen adapters. For now keep the defaults listed in the Failover Order screen and click ***Next***. Review the adapters listed and click ***Finish*** completing the process.

These adapters will now show up in the GUI under the Network Adapters tab.

Step A4: Associate VMkernel Ports to Physical Adapters

The next step is used to create the individual path bindings for each VMkernel to a NIC. This is required in order to take advantage of the new advanced features such as Round Robin MPIO or 3rd party MPIO plug-ins that will be available from Dell.

From our previous step there are 6 VMkernel ports and 2 NICs. This means that each NIC will have 3 VMkernel ports assigned to it. Again, each environment will differ and these numbers can change based on the number of NICs and the number of paths assigned. If we ever add a third NIC then we would rebalance the number of VMkernel ports to two ports per NIC.

This process can be done either via CLI or through the vCenter GUI.

By default, both vmnic2 and vmnic3 are assigned to each VMkernel port. We need to remove one vmnic from each VMkernel port so that each VMkernel port has only one uplink.

Before running these commands the switch information looks like the following (obtained using esxcfg-vswitch –l again):

Switch Name	Num Ports	Used Ports	Configured Ports	MTU	Uplinks
vSwitch2	64	9	64	9000	vmnic3,vmnic2

PortGroup Name	VLAN ID	Used Ports	Uplinks
iSCSI6	0	1	vmnic2,vmnic3
iSCSI5	0	1	vmnic2,vmnic3
iSCSI4	0	1	vmnic2,vmnic3
iSCSI3	0	1	vmnic2,vmnic3
iSCSI2	0	1	vmnic2,vmnic3
iSCSI1	0	1	vmnic2,vmnic3

You can see that there are two vmnics in each uplink for each VMkernel Port. This is what we need to change so that only a single vmnic is in each uplink and that we manually load balance them across all available VMkernel Ports.

To configure this process via CLI first note the vmnic number of the NICs you want to remove and type the following command:

esxcfg-vswitch –p iSCSI1 –N vmnic3 vSwitch2

What this will do is remove vmnic3 from VMkernel port iSCSI1 so that just vmnic2 is on iSCSI1.

We then need to do the same thing for the other 4 VMkernel ports making sure to remove vmnics so that an equal number of VMkernel ports are on each vmnic (3 per vmnic).

esxcfg-vswitch –p iSCSI2 –N vmnic3 vSwitch2
esxcfg-vswitch –p iSCSI3 –N vmnic3 vSwitch2
esxcfg-vswitch –p iSCSI4 –N vmnic2 vSwitch2
esxcfg-vswitch –p iSCSI5 –N vmnic2 vSwitch2
esxcfg-vswitch –p iSCSI6 –N vmnic2 vSwitch2

In an example where there are 3 or more vmnics, you would remove each one from the vSwitch to make sure there is only a single vmnic per uplink.

To verify that this was done correctly type the following command:

esxcfg-vswitch –l

The output will look similar to this:

Switch Name	Num Ports	Used Ports	Configured Ports	MTU	Uplinks
vSwitch2	64	9	64	9000	vmnic3,vmnic2

PortGroup Name	VLAN ID	Used Ports	Uplinks
iSCSI6	0	1	vmnic3
iSCSI5	0	1	vmnic3
iSCSI4	0	1	vmnic3
iSCSI3	0	1	vmnic2
iSCSI2	0	1	vmnic2
iSCSI1	0	1	vmnic2

The important thing to note is that under the Uplinks section there is only one vmnic assigned to each iSCSI VMkernel port and that they are evenly distributed across them all.

This can also be done through the vCenter GUI. To configure this from the GUI first navigate to the Networking section on the ESX host you are configuring. ***Configuration -> Networking***.

From here, click P***roperties*** on the vSwitch2.

Select one of the VMkernel Ports, in this example iSCSI1 and click ***Edit***.

From here select the ***NIC Teaming*** tab.

Here you are going to select the check box for ***Override vSwitch Failover Order***.

Just like in the CLI example we will assign vmnic2 to iSCSI1. This is done by selecting the adapter that is not going to be assigned to the VMkernel (vmnic3 in this case) and clicking the ***Move Down*** button until it is listed under Unused Adapters. Click ***Ok*** to complete the process. Do this same thing for each of the iSCSI VMkernel ports so that each VMkernel port is mapped to only one adapter and they are balanced across them all. In this example we assigned iSCSI1, iSCSI2 and iSCSI3 to vmnic2 and assigned iSCSI4, iSCSI5 and iSCSI6 to vmnic3.

Step A5: Enable VMware iSCSI Software Initiator

The next step, if it has not been done already, is to enable the iSCSI initiator to prepare the ESX host to connect to the PowerVault SAN. This can be done either through a CLI command or through the vCenter GUI.

To enable the iSCSI initiator through the CLI type the following command:

esxcfg-swiscsi –e

This will enable the software iSCSI initiator. To verify that it is enabled type the following command:

esxcfg-swiscsi –q

This can also be accomplished by using the vCenter GUI.

From the GUI first navigate to ***Configuration -> Storage Adapters***. Select the iSCSI Software Adapter and click ***Properties***.

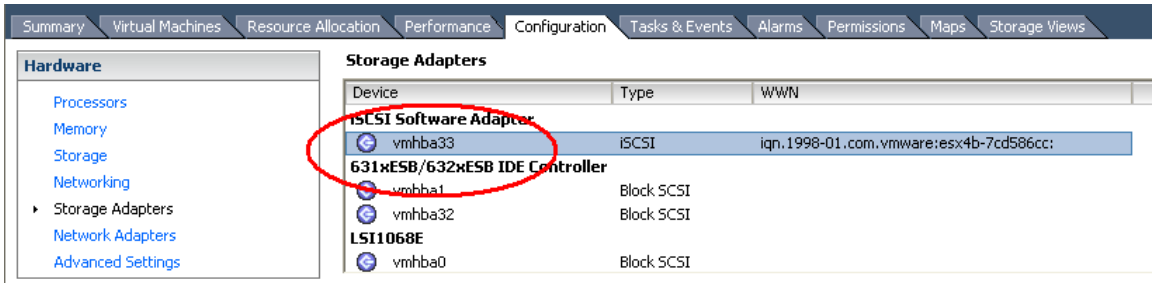
Under the General tab click the ***Configure*** button. Place a check mark in ***Enabled*** and hit ***Ok***.

This will enable the iSCSI initiator and assign a unique iqn to the ESX host.

Step A6: Binding VMkernel Ports to iSCSI Software Initiator

This next step will bind the VMkernel ports that were configured in Step 4 earlier, to the iSCSI Software Initiator. If this step is skipped there will only ever be a single connection to the PowerVault SAN. This step must be done via CLI.

The first thing to do is to note the vmhba# of the iSCSI Software Initiator. This can be seen in the vCenter GUI under ***Configuration -> Storage Adapters***.



This can also be found by running the following CLI command to discover all SCSI devices including the iSCSI software adapter:

esxcfg-scsidevs –a

The output will look something like the following:

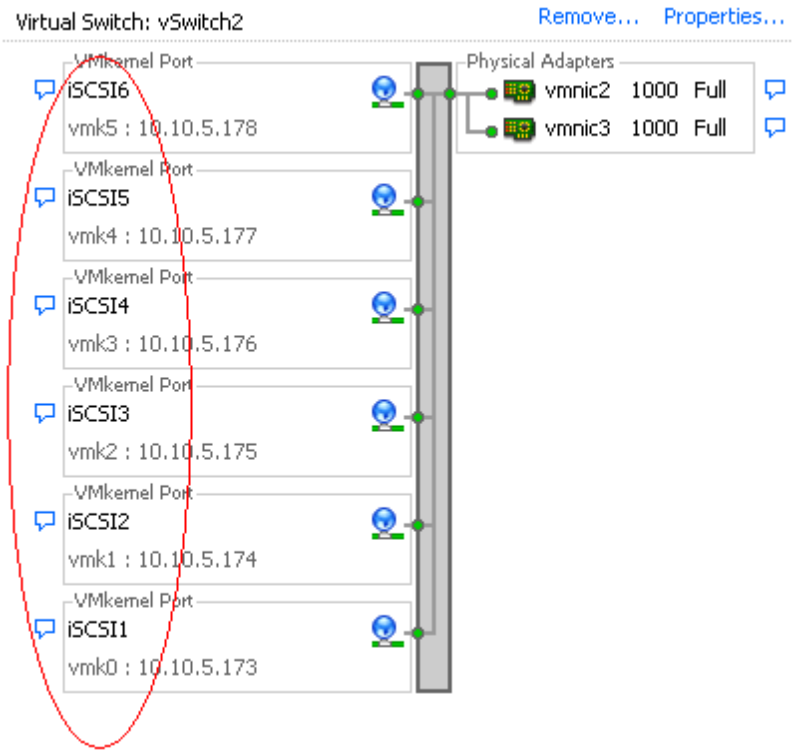
vmhba33 iscsi_vmk link-n/a iscsi.vmhba33
() Software iSCSI

In this example from both the GUI and CLI we can determine that the vmhba# for the iSCSI Software Initiator is vmhba33. This will be used in the next part. This will differ on various systems based on the devices installed.

The next piece of information to gather is the vmk# of each of the VMkernel ports. This can be done via the GUI or CLI.

To determine the vmk# of each VMkernel port from the GUI navigate to ***Configuration -> Networking***. From the vSwitch that was created earlier under each VMkernel port, the vmk# will be listed.

NOTE: It is important to recognize that they may not start with vmk0, VMotion ports and other VMkernels will utilize the same numbers based on the order they are created.



In this example we see that iSCSI1 is vmk0, iSCSI2 is vmk1, iSCSI3 is vmk2 and iSCSI4 is vmk3. This is also information that we need to note.

We can also see this in the CLI by using the following command:

esxcfg-vmknic –l

The output will look similar to this:

Interface Port Group/DVPort IP Family IP Address
Netmask Broadcast MAC Address MTU TSO MSS
Enabled Type
vmk0 iSCSI1 IPv4 10.10.5.173
255.255.255.0 10.10.5.255 00:50:56:7b:d8:3e 9000 65535 true
STATIC
vmk1 iSCSI2 IPv4 10.10.5.174
255.255.255.0 10.10.5.255 00:50:56:7e:ae:80 9000 65535 true
STATIC
vmk2 iSCSI3 IPv4 10.10.5.175
255.255.255.0 10.10.5.255 00:50:56:74:a4:e0 9000 65535 true
STATIC
vmk3 iSCSI4 IPv4 10.10.5.176
255.255.255.0 10.10.5.255 00:50:56:70:80:a7 9000 65535 true
STATIC
vmk4 iSCSI5 IPv4 10.10.5.177
255.255.255.0 10.10.5.255 00:50:56:77:f2:64 9000 65535 true
STATIC
vmk5 iSCSI6 IPv4 10.10.5.178

255.255.255.0 10.10.5.255 00:50:56:7d:b5:f2 9000 65535 true
STATIC

We can determine the same information as was found from the GUI.

Now that we know the vmhba# and the vmk# we can map each VMkernel Port to the iSCSI Software Initiator. This is done through the CLI by typing the following command:

esxcli swiscsi nic add –n vmk0 –d vmhba33

This will bind the vmk0 VMkernel port to the iSCSI Software Adapter vmhba33. We then proceed to bind all of the other vmk# to the same vmhba.

esxcli swiscsi nic add –n vmk1 –d vmhba33
esxcli swiscsi nic add –n vmk2 –d vmhba33
esxcli swiscsi nic add –n vmk3 –d vmhba33
esxcli swiscsi nic add –n vmk4 –d vmhba33
esxcli swiscsi nic add –n vmk5 –d vmhba33

To verify that all of the vmk# are bound properly to the vmhba run the following command:

esxcli swiscsi nic list –d vmhba33

This will list all of the information for VMkernel ports that are assigned to the iSCSI Software Adapter.

Step A7: Connect to the Dell PowerVault Storage

Now that the iSCSI initiator has been configured properly, follow steps 7 through 10 above to assign the new volumes and make them available for use.

One thing you will note is the increased number of connections seen in the connection tab of the volume inside the PowerVault Storage administrator.